Three New Species of Lopescladius Oliveira, 1967 (syn. "Cordites" Brundin, 1966, n. syn.), with a Phylogeny of the Parakiefferiella group

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ABSTRACT. — LOPESCLADIUS Oliveira, 1967 is shown to be the valid name for *Cordites* Brundin, 1966, illustrated from pupa. Diagnoses for all stages are given. Males and pupae of two new species, *Lopescladius fittkaui, Lopescladius verruculosus,* the male of one new species *Lopescladius inermis,* and the pupae of six more species are described. The mainly Neotropical (, but also Nearctic) *Lopescladius* is shown to be a member of the *Parakiefferiella* group *(Lopescladius, Gynnidocladius* Subl. et Wirth, *Rheosmittia* Brund., *Parakiefferiella* Thien., *Stilocladius* Rossaro, *Saetheriella* Halv., *Krenosmittia* Thien., *Epoicocladius* Zavř.) with *Gynnidocladius* from the subantarctic Campbell Island as its sister genus. *Rheosmittia* apparently form the sister group of these two genera combined.

Male imagines of *Lopescladius* Oliveira associated with numerous pupal exuviae and collected by D. E.J. Fittkau, Zoologisches Staatssammlung, Munich, from Brazil and Mexico were sent me by Dr. F. Reiss, also of Zoologisches Staatssammlung, for description of the pupal stage. A closer examination revealed that the pupae were identical to *"Cordites"* Brundin as described by Brundin (1966) on pupae only and thus an invalid name. The specimens from near Manaus in Brazil, and from near Tocuman in Mexico, belonged to two closely related species both apparently differing from the only previously described species, *Lopescladius minutissimus* Oliveira. Later I received pupal exuvia collected by Dr. Fittkau from Peru and Brazil and belonging to yet another six species. Dr. W.P. Coffman, University of Pittsburgh, in collaboration with Dr. S.S. Roback, The Academy of National Sciences, Pittsburgh, is describing all stages of a new species of *"Cordites."* I received mature pupae from Dr. Coffman for comparison. Although the male genitalia of their species is quite dissimilar, the remaining male characters as well as the pupae clearly show that also this species is congeneric with *Lopescladius,* but possibly deserve a separate subgenus. After presenting this paper I received the male of an additional new species from Dr. Ferrington, University of Kansas.

The general terminology in the following descriptions follows Sæther (1980). The measurements are given as ranges followed by a mean when three or more specimens are measured; n = number measured. The types are deposited in the Zoologisches Staatssammlung, Munich (ZSM) and Museum of Zoology, Bergen (ZMBN).

Lopescladius Oliveira, 1967:417

Cordites Brundin, 1966; 428, invalid name I.C.Z.N. 13b, n. syn.
Unknown gen. & sp. near *Corynoneura;* Roback 1953:113.

Type species: Lopescladius minutissimus Oliveira, 1967:417, by original designation.

Other included species: Lopescladius fittkaui n. sp., *Lopescladius inermis* n. sp., *Lopescladius verruculosus* n. sp., *Lopescladius* sp. *A* (pupa), *Lopescladius* sp. *B* (pupa), *Lopescladius* sp. *C* (pupa), *Lopescladius* sp. *D* (pupa), *Lopescladius* sp. *E* (pupa), *Lopescladius* sp. *F* (pupa), *Lopescladius* n. subgen., n. sp. (Coffman and Roback in prep.).

Diagnostic characters. — The combination of strongly protruding, but small, strongly pubescent to short haired eyes; reduced antepronotum; wing broad, without costal extension, with R_{2+3} fused with R_{4+5}, high VR, Cu_1 straight, and squama bare; cordiform ta_4 and small pulvilli; gonostylus bent medially with apical megaseta absent; inferior volsella minute and spine-like *(Lopescladius s. str.)* or broadly digitiform *(Lopescladius* n. subgen.); and gonocoxite (in *Lopescladius s. str.)* with caudal elongation; easily separates the males from all other orthoclads.

The pupae are characterized by the lack of frontal setae and thoracic horn; the unique leg sheath arrangement with all leg sheaths directed straight backwards with apices joined along sutures; the presence of caudal spines on tergites (I) II-VIII and sternites II-VII (♀) or II-VIII (♂); the absence of hooklets on tergite II and of pedes spurii A and B; and the anal lobe without fringe, with long, apical, dorsally curved, digitiform, moveable projections each carrying 3 equally long macrosetae.

The larvae are characterized by a long antenna longer than head capsule with a long whip-like ultimate segment; S I bifid; premandible with 1 apical tooth and fine brush; mandible with short apical tooth and 6 inner teeth, setae interna present; mentum with broad median tooth and 5 pairs of lateral teeth; separate, claw-bearing parapods; and procercus with 1 strong anal seta.

Male. — Eyes small, strongly protruding, with microtrichia as long as the height of an ommatid (hence between pubescent and hairy). Antenna with 11-13 flagellomeres; antennal groove reaching flagellomere 4-5; flagellomeres 2, 3, 4 and ultimate with sensilla chaetica; setal plume weak, with one stronger developed and one weakly developed whorl of setae on each flagellomere; AR between 0.4 and 1.3. Temporals apparently absent. Palp 5-segmented, segments progressively longer, third segment with 1 weak sensillum clavatum. Antepronotum more or less reduced, lobes narrowed medially, separated or in narrow contact, without or with 1 lateral seta. Dorsocentrals few, anterior ones stronger than posterior ones; acrostichals apparently absent; about 2 prealars. Scutellars few, in transverse row. Wing broad, membrane with fine punctation of microtrichia barely visible at 350 X. Anal lobe indicated. Costa not or barely extended, ending between M_{3+4} and Cu_1; R_{2+3} fused with R_{4+5}, partially indicated as a line; vannal fold ends distad, An basad to FCu; Cu_1 straight; brachiolum with 1 setae, other veins and squama all bare. Sensilla campaniformia about 6 at base of brachiolum, 3 below seta, and about 6 at apex of brachiolum; 1 at base of subcosta, 1 on FR, and 1 at base of R_1. Pulvilli very small, but distinct. Comb and hind tibial spurs normal. Pseudospurs and sensilla chaetica absent. BV and SV high, ta_4 strongly cordiform. Setae of abdomen very few, often only 1 very long seta on each tergite. Anal point absent, tergum IX at most with a few weak setae. Phallapodeme well developed, with triangular or rounded aedeagal lobe. Transverse sternapodeme broadly curved to nearly straight with or without weak oral projections. (The preparations of two of the described males are not very good with the apodemes indistinct.) Gonocoxite without inferior volsella or, with a spine-like inferior volsella *(Lopescladius s. str.),* or with a broadly digitiform, bare inferior volsella *(Lopescladius* undescribed subgenus); with a long *Protanypus*-like apical extension *(Lopescladius s. str.)* or without such an extension (*Lopescladius* n. subgen.) Gonostylus with a more or less distinct median bend, without crista dorsalis and apical megaseta.

Pupa — Minute pupae (1.3-3.3 mm long). Frontal setae absent. Frontal apotome without anterior triangular projection, evenly and weakly rounded to reniform shape, smooth to strongly rugulose. Antennal sheath above pedical without pearls to covered with rugulosity. Ocular field with 1 weak postorbital only. Thoracic horn absent. Dorsocentrals 4, 2 anterior and 2 posterior grouped. Thorax rugulose. Wing sheath smooth or rugulose and reticulate. Leg sheaths all directed straight backwards with apices joined along sutures, front leg sheath ending at conjunctives I/II, mid leg in the middle of tergite II and slightly basad of apex of wing sheath, hind leg ending at conjunctive II/III. Abdomen arched. Tergite I and sternites I and IX without shagreen; tergites II-IX and sternites II-VIII with transverse rows of fine group shagreen to very strong spinules in anterior third to half, with reticulation of polygones often with smaller pattern of more faint polygone reticulation inside. Tergites I (II)-VIII and sternites II-VII (♀) or II-VIII (♂) with caudal rows of erect spines. Tergite II without hooklets. Conjunctives of tergites and sternites with small distinct to indistinct greyish polygones. Pedes spurii A and B absent. Segment I with 5 pairs of D setae, 3 pairs of V setae and 3 pairs of L setae. Segments II-VII each with 4 hair-like L setae, 1-2 of them very small; segment VIII with 2 hair-like L setae. Setae D_2, D_5, V_3 and V_5 broad, lamelliform; tergite VIII with 3 pairs of D setae. O setae and apophyses absent. Anal lobe without fringe, with long, apical dorsally curved, digitiform, moveable, smooth, wrinkled or rugulose projections each carrying 3 equally long macrosetae. Genital sac also curved dorsad.

Larva — A description will be given by Coffman and Roback (in prep.) and Cranston, Oliver and Sæther (1982).

SYSTEMATICS

The male imago of *Lopescladius s. str.* look strikingly different from other orthoclads. The extremely protruding eyes; the broad wings; the distinctly cordiform, *Cardiocladius*-like ta_4; the absence of a megaseta; and the *Protanypus*-like elongation of the gonocoxite; appears to indicate relationships with plesiomorphic genera as well as with highly derived genera. Also the pupa is unique, particularly with respect to the leg sheath arrangement and the projections of the anal lobe. The larva is peculiar, but do, however, show some similarities with other genera such as *Rheosmittia* Brundin (Cranston & Sæther in ms).

In the key to male Orthocladiinae by Brundin (1956) *Lopescladius* will key to *Camptocladius* v.d. Wulp from which it, however, differs in a number of significant details. The Cu_1 is straight which contradicts a placement in either of the *Smittia, Parakiefferiella* or *Pseudosmittia*-groups. However, as shown by Sæther (1981) for some species of *Smittia* Holmgr. and *Pseudosmittia* Goetgh., the straight Cu_1 almost certainly is a result of FCu being moved far distad and is not an original plesiomorphous condition. The medially bent gonostylus of *Lopescladius* is very similar to and found only in some members of the *Parakiefferiella*-group namely *Rheosmittia* Brund., *Gynnidocladius* Subl. & Wirth, *Parakiefferiella* Thien., and *Stilocladius* Rossaro (Brundin 1956, Sublette & Wirth 1980, Sæther 1982, Cranston & Sæther in ms). The same genera and *Lopescladius* also have some members with reduced numbers of flagellomeres; all except *Stilocladius* and some *Parakiefferiella,* but with the addition of *Krenosmittia* Thien, have R_{2+3} fused with R_{4+5}; all except *Parakiefferiella,* but with the addition of *Saetheriella* Halvorsen (1982), have pubescent to hariy eyes; and they probably all (the larva of *Gynnidocladius* is not known) have a whip-like ultimate larval antennal segment. The pupal anal lobe have an apical elongation of differing shape in all known pupae of the *Parakiefferiella*-group; the pulvilli are present, but small or vestigial probably in all genera; and the ante-pronotum is somewhat reduced except in *Epoicocladius* Zavř. and in some *Parakiefferiella.* All in all, *Lopescladius* clearly appear to be an aberrant and apomorphic member of the *Parakiefferiella*-group. Whether this group perhaps should include some other genera, particularly of the *Pseudosmittia* group, which share a few of the same apomorphous features cannot be decided without a better knowledge of the immature stages and of the females.

Although the same restrictions applies to the *Parakiefferiella* group as here outlined a tentative shceme of argumentation delineating the cladogensis of the genera can be attempted (Fig. 1). Trends showing the same direction are grouped. The following trends are used (a = apomorphous, p = plesiomorphous):

TRENDS 1 — Eyes reduced, strongly protruding (a); less protruding (p).
— Costal extension reduced (a); long (p).
— Cu_1 secondarily straightened (see above) (a); curved (p).
— Distinctly cordiform ta_4 (a); slightly cordiform to cylindrical ta_4 (see Trends 3) (p).

— Anal point absent (a); present (p).
— Megaseta of gonostylus lost (a); present (p).
— Leg sheath arrangement of pupa unique (see above) (a); normal (p).
— Projections of anal lobe very long and moveable (a); short to long, not moveable (p). (Several other trends could be added)

TREND 2 — Male antenna reduced to 5 nonplumose flagellomeres (a); 11-13 plumose flagellomeres (p).

TRENDS 3 — Slightly to distinctly cordiform ta_4 (a); cylindrical ta_4 (p).
— Anal point reduced or absent (a); well developed (p).
— Acrostichals and scutal tubercle absent (a); acrostichals and/or scutal tubercle present (The acrostichals may be secondarily reduced also in *Rheosmittia* (see trends 5). Whether acrostichals are present or absent in *Krenosmittia* has not been examined. Other genera of the *Parakiefferiella* group all have acrostichals, or scutal tubercle or tuft.)
— Cu_1 straight or at most sharply downcurved at apex (a); Cu_1 sinuate (p). (The sinuate Cu_1 is a synapomorphy for the *Smittia* - *Parakiefferiella* - *Pseudosmittia* groups, and symplesiomorphous within these groups.)

TRENDS 4 — Scutum extending hunch-like forward (a); normal (p).
— Anal macrosetae of pupa absent (a); well developed (p).
(Although the pupa of *Gynnidocladius* is not known it will in all likelihood not possess the autapomorphies of *Rheosmittia*.)
— D_5 of pupal tergites II or III to IV flattened and finely split (a); normal (p).

TRENDS 5 — VR higher than 1.4 (a); VR lower than 1.4 (p). (Secondarily high also in *Epoicocladius*)
— Acrostichals and scutal tubercles absent in all or some species of each genus, i.e. tendency to reduction present (a); present (p).
— R_{2+3} fused with R_{4+5} (a); R_{2+3} not fused (or secondarily fused in some *Parakiefferiella* and in *Krenosmittia*) (p).

TREND 6 — Eyes naked without trace of microtrichia between central ommatids (a); eyes pubescent or hairy (p). (See Trends 11).

There is some doubt whether *Parakiefferiella* really is monophyletic as male *P. coronata* (Edw.) differ distinctly from the other members. However, the immatures appear quite similar to other members of the genus.

TRENDS 7 — R_{2+3} fused with R_{4+5} in all or at least some species of each genus; i.e. tendency to fusion present (a); R_{2+3} separate and distinct (secondarily fused in *Krenosmittia*) (p).

TRENDS 8 — Anal point narrowed (a); broad-based (p).
— Hind tibial comb very oblique (a); normal (p). (The same tendency to an oblique comb is found also in *Saetheriella*.)
— Anal lobe projection reduced (a); present (p). (This trend is regarded as a secondary reduction since *Stilocladius* possesses the synapomorphies of trend 9.)

TRENDS 9 — Gonostylus with a characteristic median bend (a); normal (p).
— All genera with some members with reduced numbers of flagellomeres (a); 13 flagellomeres (p). (*Epoicocladius gynocera* (Edw.) have completely female antenna. Howver, as the immatures are unknown the placement is uncertain. Furthermore, the complete feminization of the antenna probably cannot be regarded as the same trend as reduction of a few flagellomeres.)

— Ultimate segment of larval antenna long, tapering, thread-like (a); normal (p). (Although the larva of *Gynnidocladius* is not known, this trend probably belongs here.)

TRENDS 10 — Costal extension short (a); long or (in *Lopescladius*) secondarily reduced (p).
— Antenna with straight apical seta (a); without (p). (This trend occurs also in the *Pseudorthocladius* and *Smittia*-groups (Sæther & Sublette 1983, Brundin 1956).)

TREND 11 — Eyes pubescent or hairy (secondarily bare in *Parakiefferiella*) (a); eyes bare (p). (This trend could be interpreted as going in the opposite direction and probably do so in more plesiomorphic groups.)

TRENDS 12 — R_{2+3} fused with R_{4+5} (a); R_{2+3} separate or secondarily fused (see trends 5 and 7).
— Larval antenna 4-segmented (a); antenna 5-6 segmented (p). (Parallelly 4-segmented in *Epoicocladius*, see trend 14.)
— Larval maxillary palp unique, Tanytarsiinae-like (a); normal (p).
— Procercus with 1 elongate anal seta, half the length of the body (a); anal setae equally long (secondarily one long anal seta in *Lopescladius*) (p).
— Pupal thoracic horn beset with scale-like plates ending in spinules (a); thoracic horn when present without plates (p).
(Several other autapomorphics could be added here.)

TREND 13 — Antepronotum reduced, with lobes narrowed medially (a); antepronotum not reduced (p).

TREND 14 — Larval antenna 4-segmented (a); antenna 5-6 segmented (secondarily 4-segmented in *Krenosmittia*) (p).
— Abdomen of larva and pupa with a thick covering of setae (a); normal amount of setae (p).
A number of other trends based on the aberrant immatures could be added.

TREND 15 — Anal lobe of pupa with an apical more or less well developed elongation (a); without (p).

A number of trends could be added here. These, however, depend on whether the combined *Heterotrissocladius* and *Cardiocladius* groups forms the sister group of the *Parakiefferiella* group as will be suggested by combining the data in Sæther (1977) and Sæther and Halvorsen (1981) or if another group is a more likely sister group.

A number of trends in the above analysis are partly contradictory. Obviously both parallel selections and underlying synapomorphies (Sæther 1979) obscure the synapomorphies. If the weighting were placed more on characters such as hairy eyes and fusion on R_{2+3} with R_{4+5} instead of on the shape of the gonostylus, the thin ultimate larval segment etc. the placement of the genera from *Krenosmittia* to *Parakiefferiella* could well be different. The placement of *Lopescladius, Gynnidocladius, Rheosmittia* and of *Epoicocladius,* however, seem relatively well founded.

It probably is premature to speculate about the zoogeographical importance of the findings since the actual distribution of many of the genera not is well known. However, the sister group relationship between the mainly neotropical *Lopescladius* and *Gynnidocladius* from New Zealand's subantarctic Campbell Island as well as the fact that *Saetheriella* and *Stilocladius* up to now are known exclusively from the southeastern states and, for the

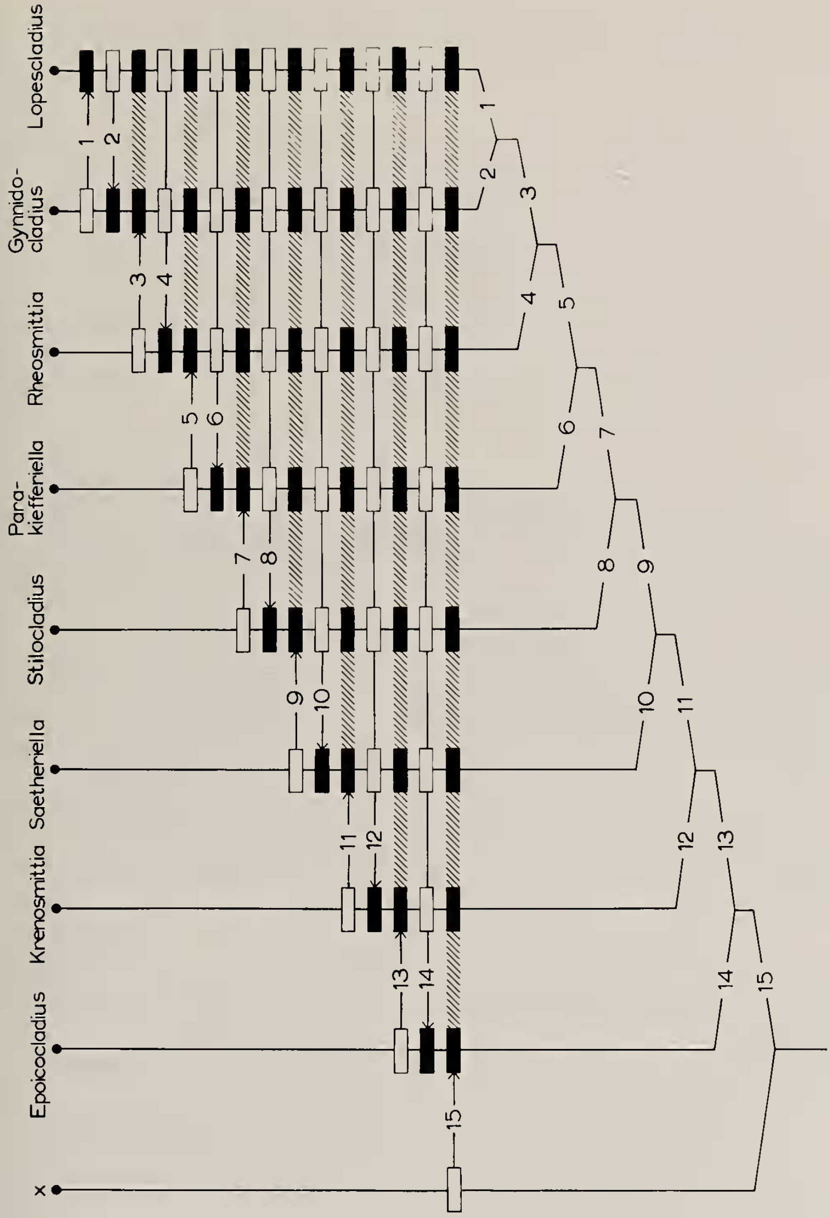


FIG. 1. Scheme of argumentation delineating the cladogenesis of the *Parakiefferiella* group by means of trends 1-15.

last genus, the part of Europe which was part of Gondwanaland , indicate a Gondwanian origin of most of the group.

KEY TO KNOWN MALES OF LOPESCLADIUS OLIVEIRA

1. Gonocoxite without caudal extension; inferior volsella broadly digitiform .... *Lopescladius* n. subgen. n. sp. (Coffman & Roback in prep.)
   Gonocoxite with caudal extension; inferior volsella spiniform or absent .... *Lopescladius s. str.* 2
2. Antenna with 11 flagellomeres, AR about 1.1; inferior volsella tapering to sharp point, bare (Fig. 2D); extension of gonocoxite without broad apical seta .... *Lopescladius fittkaui* n. sp.
   Antenna with 13 flagellomeres, AR higher than 1.2 or lower than 0.8; inferior volsella with a parallelsided base, median seta, and a tapering apex (Fig. 2E) or absent; extension of gonocoxite with or without a broad apical seta 3
3. AR about 0.75; inferior volsella and broad seta of gonocoxite extension present (Fig. 2E) .... *Lopescladius verruculosus* n.sp.
   AR higher than 1.2 or lower than 0.6; inferior volsella and broad seta of gonocoxite extension absent (Fig. 5; Oliveira 1967 fig. 3) 4
4. AR about 1.3 .... *Lopescladius minutissimus* Oliveira (Oliveira 1967 fig. 3)
   AR about 0.5 .... *Lopescladius inermis* n. sp.

KEY TO KNOWN PUPAE OF LOPESCLADIUS OLIVERIA

1. Spinules of anterior shagreen bands on tergites and sternites strong, spine-like; anal lobe projection rugulose, about equally wide in the middle as at base, about 2.3 times as long as wide; total length about 2.4 mm .... *Lopescladius* n. gen. n. sp. (Coffman & Roback in prep.)
   Spinules of anterior shagreen bands not conspicuously strong; anal lobe projection smooth or when rugulose pupa more than 3.0 mm long, projection widest at base, about 2.6 times as long as wide; total length 1.3-2.1 mm or 3.0-3.3 mm.. *Lopescladius s. str.* 2
2. Exuvia dark brown; total length 3.0-3.3 mm; anal lobe projection very distinctly rugulose (Fig. 6F)... *Lopescladius* sp. *F*
   Exuvia pale yellowish to greyish brown; total length 1.3-2.1 mm; anal lobe projection smooth to slightly rugulose 3
3. Extensive rugulosity extends onto frontal apotome, antennal and wing sheaths (Fig. 4A, B) 4
   Rugulosity well developed, but frontal apotome, antennal and wing sheaths smooth or at most slightly wrinkled or rugulose (Fig. 3A)............................. 5
4. Lateral rugulosity of abdominal segments extending for most of the length of each segment (Fig. 4D), digitiform projections of anal lobe 90-113 μm long and about 2.8 times as long as basally wide .... *Lopescladius verruculosus* n.sp.
   Lateral rugulosity of abdominal segments restricted to medial half (Fig. 4E); digitiform projections of anal lobe 75-83 μm long and about 3.4-3.7 times as long as basally wide .... *Lopescladius* sp. *E*
5. Tergite I with more than 2 posterior spines (Fig. 6A, B) 6
   Tergite I usually without, at most with 2 weak, posterior spines (Fig. 3D) 8

6. Anal lobe projection slightly wrinkled (Fig. 6E) to distinctly rugulose medially (Fig. 6D) or near apex, 109-135 μm long and 1.2-1.4 times as long as anal macrosetae; exuvia greyish brown 7
   Anal lobe projection nearly smooth, 86-101 μm long and 0.9-1.1 times as long as anal macrosetae; exuvium very pale yellowish .... *Lopescladius* sp. *A*
7. Anal lobe projection distinctly rugulose medially (Fig. 6D) 120-135 μm long, about 3.6-4.1 times as long as basally wide .... *Lopescladius* sp. *C*
   Anal lobe projection slightly wrinkled but not rugulose (Fig. 6E) 109-116 μm long, about 2.9-3.1 times as long as basally wide .... *Lopescladius* sp. *D*
8. Exuvium very pale greyish yellow including cephalothorax; anterior spinules in shagrenation of segments very sparse, present mostly only anteriolaterally .... *Lopescladius* sp. *B*
   Exuvium with brown cephalothorax and pale greyish brown abdomen; anterior spinule bands weak but nearly complete (Fig. 3D) .... *L. fittkaui* n. sp.

Lopescladius fittkaui n. sp.

Type locality: Brazil, Amazonas, near Manaus, Reserva Duke.

Type Material: Holotype, male, light trap, Upper Rio Marauia, Estado Amazonas, Missionstation Sao Antonio, Brazil, 9/1/1963, E.J. Fittkau, in the collection of Zoologisches Staatssammlung, Munich, West Germany (ZSM, number on slide A 473). Paratypes, male, as holotype, drift, undisturbed forest, Igarapé Barro Branco, Reserva Duke, near Manaus, Estado Amazonas, Brazil, mature male pupa, 11 pupal exuvia 8-10/5/1961, E.J. Fittkau, A 174-1; 1 exuvium, as above except 2/2/1961, A 116-1 (ZSM, ZMBN).

Diagnostic characters: See key on p. 286.

Etymology: Named in honour of Dr. E.J. Fittkau, Zoologisches Staatssammlung, Munich, the collector of two of the new species described here.

Male imago (n = 2 except when otherwise stated)
Total length about 1.3 mm (1). Wing length 0.58-0.60 mm. Total length/wing length about 2.2 (1). Wing length/length of profemur 3.33-3.44. Coloration yellowish brown.

Head (Fig. 2A). Antenna with 11 flagellomeres, ultimate flagellomere 131 μm (1) long, AR 1.09 (1). Clypeus with 2 setae. Cibarial pump, tentorium and stipes as in Fig. 2A. Tentorium 56 μm (1) long, 7 μm (1) wide. Palp lengths/(micrometers, n = 1): 8, 9, 17, 32, 45.

Thorax (Fig. 2B). Antepronotum with 1 lateral seta. Dorsocentrals apparently 3-4, prealars 2. Scutellum with 2 setae.

Wing (Fig. 2C). VR 1.51-1.56.

Legs. Spur of front tibia 19 μm long, spurs of middle tibia 15μm and absent, of hind tibia 26μm and 8-9 μm. Width at apex of front tibia 17-18 μm, of middle tibia 15 μm, of hind tibia 20 μm. Comb with 7-8 setae, 11-17 μm long. Lengths (micrometers) and proportions of legs:

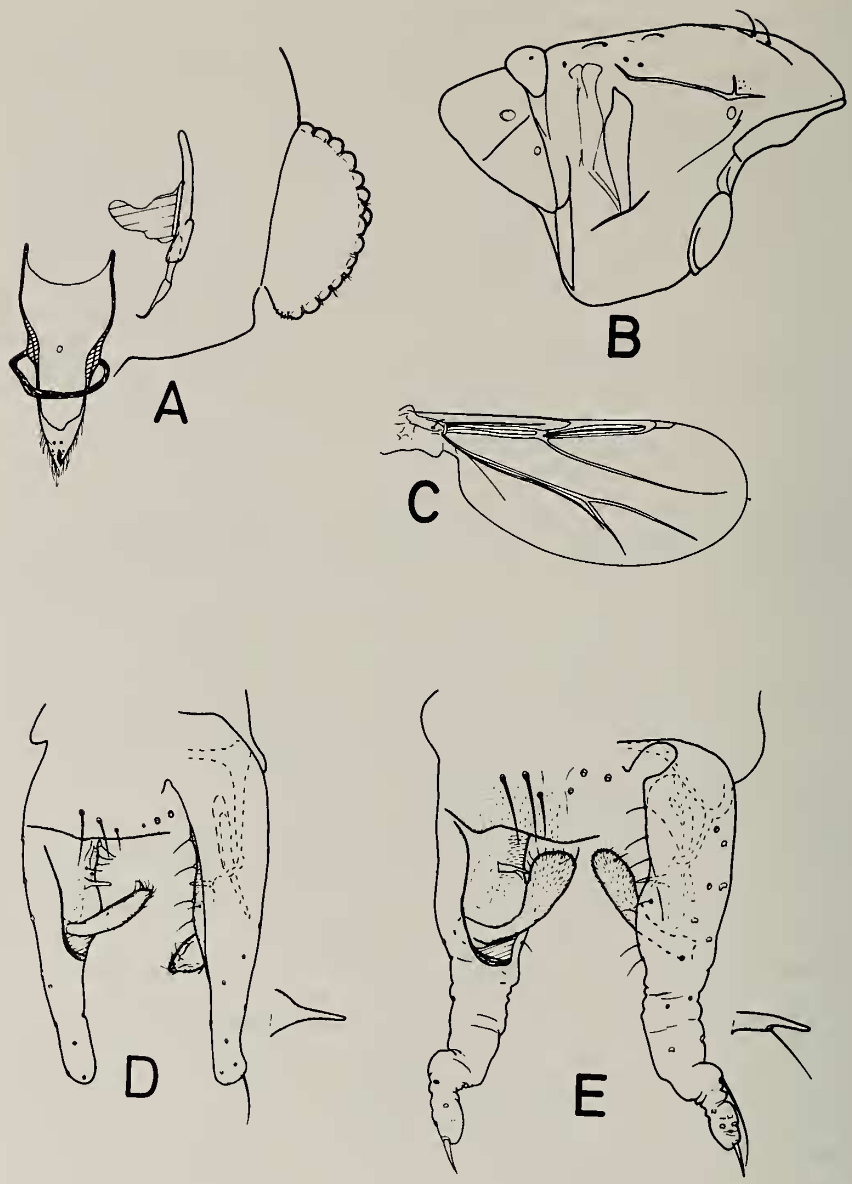


FIG. 2. *Lopescladius* spp., male. — A-D. *L. fittkaui* n. sp. — A. Eye, cibarial pump, tentorium and stipes. — B. Thorax. — C. Wing. — D. Hypoygium — E. *L. verruculosus,* hypopygium.

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5
p_1	173	188-203	75-79	41	30	11	23
p_2	225-236	236-249	83-84	34	23	11	19-21
p_3	176-184	227-240	69-73	32-34	23-26	9-11	19-21

	LR	BV	SV	BR
p_1	0.39-0.40	4.14-4.32	4.76-4.80	1.7-1.8
p_2	0.34-0.35	6.17-6.61	5.50-5.76	2.3
p_3	0.31-0.34	5.52-5.60	5.79-5.80	1.9-2.0

Hypopygium (Fig. 2D). Tergum IX with 4-6, 5 (3) setae; laterosternite IX apparently bare. Apodemes not measurable. Gonocoxite 143μm (3) long, distance from base to base of gonostylus 79-83μm; inferior volsella tapering, bare, 10-13μm long, 4-5μm wide at base, 1.5μm side one third from base. Gonostylus 38-41, 39μm (3) long. HR 3.45-3.80, 3.68 (3); HV about 3.2.

Pupa (n = 10 except when otherwise stated)

Total length 1.51-1.86, 1.65 mm. Thorax of exuvia brown, abdomen pale greyish brown.

Cephalothorax (Fig. 3A-C). Frontal apotome (Fig. 3A), antennal sheath and wing sheath smooth. Postorbital 19-23, 22μm (3) long. Median antepronotal setae 41-49, 43μm (8) and 30-49, 37μm (8) long; lateral antepronotals 38-41, 38μm (9) and 4-11, 6μm (8) long. Posterior precorneal seta (Fig. 3A) 38-45, 40μm (8) long; median and anterior both 26-38, 32μm long. Anterior two dorsocentrals (Dc_1, Dc_2) both 26-45, 39μm (9) long; Dc_3 8-26, 15μm (8) long; Dc_4 15-38, 26μm (8) long. Distance between Dc_1 and Dc_2 11-21, 15μm; between Dc_2 and Dc_3 88-116, 100μm; between Dc_3 and Dc_4 9-34, 22μm.

Abdomen (Fig. 3D-G). Shagrenation and chaetotaxy as in Figs. 3D-G and generic diagnosis. Number of caudal spines on tergites I-VIII as: 0-2, 0; 9-15, 12; 10-14, 11; 9-13, 11; 9-12, 11; 8-13, 10; 8-14, 10; 6-10, 8. Number of caudal spines on sternites II-VIII as: 4-7, 5; 8-11, 9; 7-11, 9; 7-11, 9; 7-10, 9; 6-10, 8; 0 (6 ♀♀), 5-9, 8 (4 ♂♂). Digitiform projection of anal lobe smooth, about 2.8 times as long as wide, 86-101, 94μm long. Anal macrosetae 83-101, 92μm long.

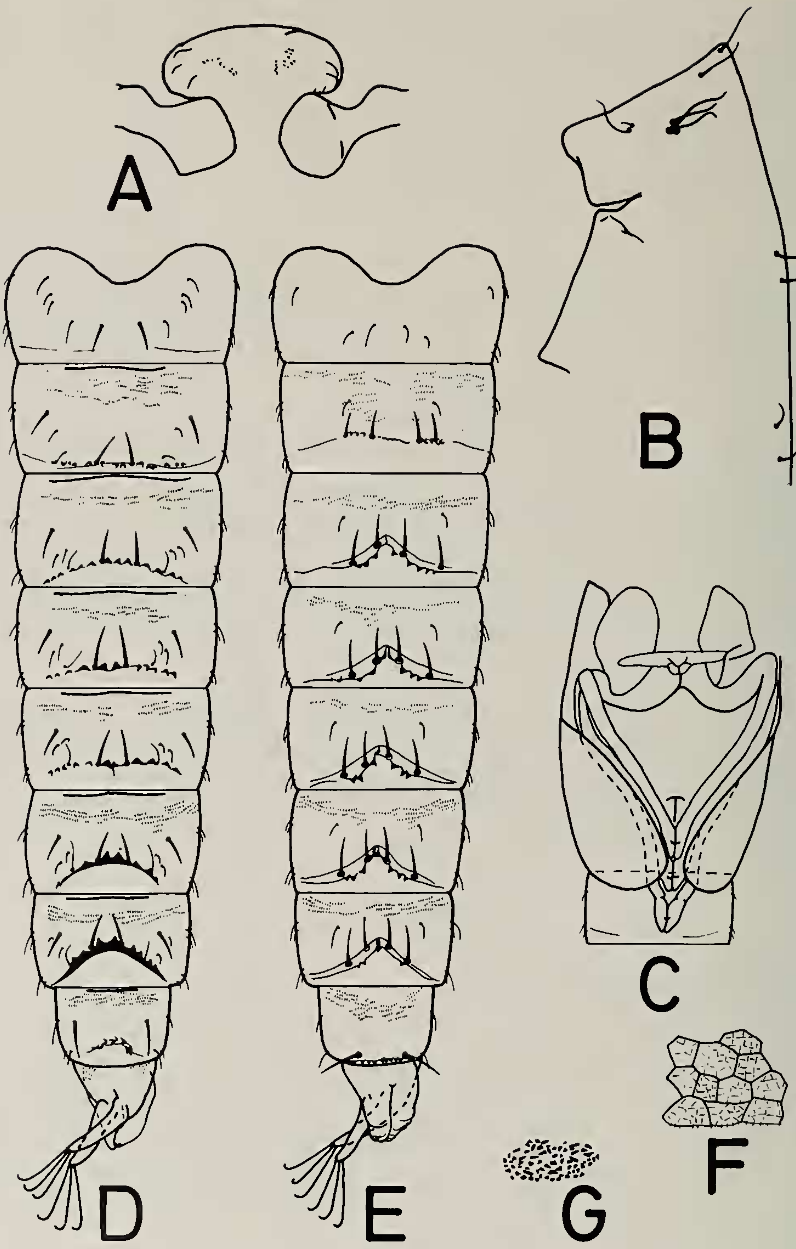
Larva. Unknown.

Lopescladius verruculosus n. so.

Type locality: Mexico, Prov. Michoacan, river mouth about 100 km south of Tocuman.

Type material: *Holotype,* male, river mouth about 100 km south of Tocuman, prov. Michocan, Mexico, April 1981, E.J. Fittkau, in the collection of Zoologisches Staatssammlung, Munich, West Germany (ZSM). *Paratypes,* 60 pupal exuvia, as holotype. *Other material:* pupa, Mississippi River, near Cordoba, Illinois, 13/9/72, D.L. Andersen (ZSM, ZMBN).

Diagnostic characters: See key on p. 286.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Etymology: From Latin *verruculosus,* full of small warts, referring to the rugulosity which extends onto the frontal apotome and the antennal and wing sheaths of the pupa.

Male imago (n = 1)
Total length about 1.4 mm. Wing length about 0.6 mm. Total length/wing length about 2.2 mm. Wing length/length of profemur about 3.3 mm. Coloration yellow brown.

Head. Antenna with 13 flagellomeres, ultimate flagellomere 128μm long, AR 0.74. Palpal segments 4 and 5 respectively 36μm and 60μm long. Other details of head not measurable.

Thorax. Antepronotum apparently bare. Dorsocentrals apparently 2-3, prealars 2. Scutellum with 2 setae.

Wing. VR not measurable.

Legs. Spur of front tibia 19μm long, spurs of middle tibia 15μm and 7μm long, of hind tibia 21μm and perhaps absent. Width at apex of front and middle tibia 19μm, of hind leg 23μm. Comb with 9 setae, 11-17μm long. Lengths (micrometers) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
p_1	191	221	86	49	39	15	26	0.39	3.86	4.78	2.0
p_2	248	244	90	43	34	15	24	0.37	5.00	5.46	2.5
p_3	210	244	71	34	26	15	24	0.29	5.28	6.37	2.0

Hypopygium (Fig. 2E). Tergum 1X with 6 setae; laterosternite 1X apparently bare. Apodemes not measurable. Gonocoxite 169μm long, distance from base to base of gonostylus 79μm; inferior volsella with median seta, 13μm long, 2.5μm wide and parallel-sided in basal half; 1.5μm wide about 0.6 from base and tapering to point, projection of gonocoxite with conspicuous spine-like apical seta. Gonostylus 60μm long, HR 2.81, HV about 2.4.

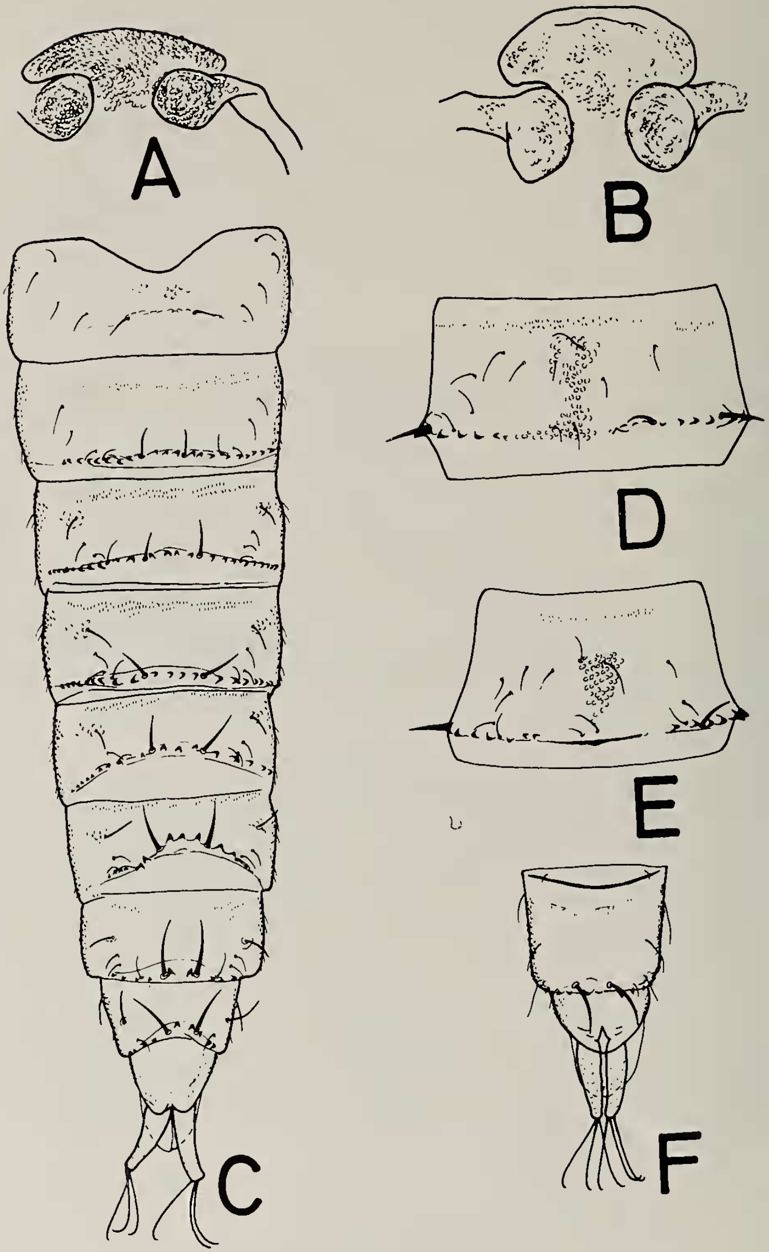
Pupa (n = 10)
Total length 1.56-1.94, 1.77 mm. Exuvia pale yellowish brown.

Cephalothorax Frontal apotome (Fig. 4A), antennal sheath and wing sheath covered with rugulosity. Postorbital 11-21, 17μm long. Median antepronotal setae 26-38, 32μm and 23-34, 26μm (8) long; lateral antepronotals 19-38, 29μm and 4-8, 6μm long. Anterior precorneal seta 15-34, 23μm long; median and posterior both 11-19, 14μm long. Anterior two dorsocentrals (Dc_1, Dc_2) and posterior dorsocentral (Dc_4) all 15-16, 20μm long, Dc_3 11-19, 14μm long. Distance between Dc_1 and Dc_2 11-23, 16μm; between Dc_2 and Dc_3 90-124, 106μm; between Dc_3 and Dc_4 6-38, 14μm.

Abdomen (Fig. 4C-D). Shagrenation and chaetotaxy as in Fig. 4C-D and generic diagnosis. Number of caudal spines on tergites 11-V111 as: 8-16, 12; 9-16, 12; 9-12, 11; 10-13, 11; 9-11, 10; 6-10, 8; 2-9, 7. Number of caudal spines on sternites 11-V111 as: 4-9, 6; 8-13, 10; 8-12, 10: 7-12, 9; 6-10, 8; 6-8, 7; 0 (♀♀), 4-7, 5 (♂♂). Digitiform projection of anal lobe smooth, about 2.8 times as long as basally wide, 90-113, 102μm long. Anal macrosetae 90-116, 103μm long.

Larva. Not known with certainty.

FIG. 3. *Lopescladius fittkaui* n. sp., pupa. — A. Frontal apotome. — B. Chaetotaxy of cephalothorax. — C. Leg sheath arrangement. — D. Tergites. — E. Sternites. — F. Reticulation and spinules of tergites. — G. Polygones of conjunctives.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Lopescladius inermis n. sp.

Type locality: U.S.A., Kansas, Meade Co., near Meade Co. State Lake.

Type material: Holotype, male, artesian spring at Meade Co. State Lake, Meade Co., Kansas, U.S.A., 16/7/80, P. Liechti & M. Orbois, in the collection of Museum of Zoology, University of Bergen (ZMBN No. 73).

Diagnostic characters: See key on p. 286.

Etymology: From Latin *inermis* meaning unarmed referring to the lack of a spine-like inferior volsella.

Male imago Total length about 1.59 mm. Wing length 0.73 mm. Total length/wing length 2.18. Wing length/length of profemur 3.24. Coloration yellowish brown with darker vittae, postnotum and lower parts of preepisternum.

Head. Antenna with 13 flagellomeres, ultimate flagellomere 137μm long, AR 0.51. Temporal setae absent except for 1 weak postorbital. Clypeus with 2 setae. Cibarial pump, tentorium and stipes as in Fig. 5A. Tentorium 71μm long, 7μm wide. Stipes 77μm long. Palp lengths (micrometers): 11, 15, 21, 30, 58.

Thorax (Fig. 5B). Antepronotum with 1 lateral seta. Dorsocentrals 4, prealars 2. Scutellum with 2 setae.

Wing (Fig. 5C). VR 1.42. Brachiolum with 1 seta, other veins bare.

Legs. Spurs of front tibia 21μm long, spurs of middle tibia 17μm and absent, of hind tibia 41μm and 15μm. Width at apex of front tibia 21μm, of middle tibia 19μm, of hind tibia 26μm. Comb with 11 setae, 9-17μm long. Lengths (micrometers) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
p_1	225	255	90	51	41	13	28	0.35	4.28	5.33	2.2
p_2	244	313	90	41	32	11	26	0.29	5.85	6.19	3.0
p_3	233	302	86	38	30	11	28	0.29	5.81	6.20	2.5

Hypopygium (Fig. 5C). Tergum IX with 7 setae, laterosternite IX apparently bare. Phallapodeme strongly developed, 99μm long, with large aedeagal lobe. Transverse sternapodeme broadly rounded without oral projections. Gonocoxite 180μm long, distance from base to base of gonostylus 116μm; inferior volsella absent, perhaps represented by a weak seta. Gonostylus 57μm long. HR 3.16, HV 2.79.

Remarks. The species appear intermediate between *Lopescladius minutissimus* and *L. fittkaui.* The hypopygium is lacking an inferior volsella as apparently also *L. minutissimus* does, while the hypopygium otherwise is very similar to that of *L. fittkaui.* Also while the antenna has 13

FIG. 4. *Lopescladius* spp., pupae. — A. *Lopescladius verruculosus,* frontal apotome and antennal sheath base. — B. *Lopescladius* sp. *E,* frontal apotome, C-D. *Lopescladius verruculosus.* — C. Abdomen. — D. Lateral view of segment IV. — E-F. *Lopescladius* sp. *E.* — E. Lateral view of segment IV. — F. Tergites VIII-IX and anal lobe.

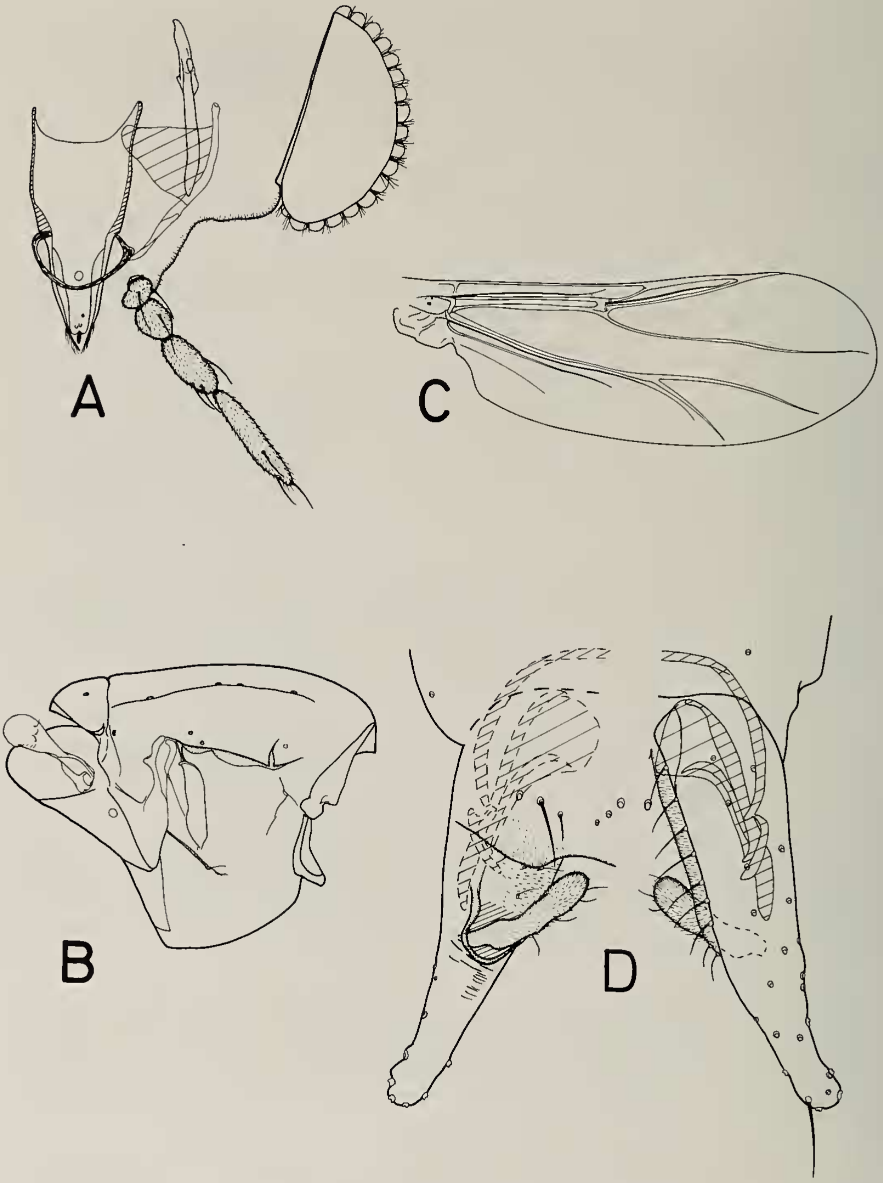


FIG. 5. *Lopescladius inermis* n. sp., male. — A. Eye, cibarial pump, tentorium and stipes. — B. Thorax. — C. Wing. — D. Hypopygium.

flagellomeres the AR is lower than in *L. minutissimus* and *L. verruculosus*. Unfortunately *L. minutissimus* could not be reexamined. However, judging on the figures the hypopygium appears similar to *L. verruculosus* and these two species combined could well form the sister group of *L. inermis* and *L. fittkaui* combined.

Lopescladius sp. **A** (Fig. 6A)

These exuvia have a pale yellowish coloration, 3-6 spines on tergite I (Fig. 5A) and a size of 1.7-2.0 mm. All other details appear identical to those of *L. fittkaui* n. sp.

Material examined: 29 pupal exuvia, left tributary to River Huallago at Huanoco, 1 900 m.a.s.l., Peru, 1963, E.J. Fittkau; 18 pupal exuvia, tributary Rio Chaohamayo at San Ramon, 1 700 m.a.s.l., Peru, 15/5/63, E.J. Fittkau.

Lopescladius sp. **B** (Fig. 6B, C)

These exuvia have a very pale greyish yellowish coloration including the cephalothorax, no caudal spines on tergite I, and a length of 1.31-1.56 mm. The anterior shagreen of the abdomen consists mostly of a few anteriolateral spinules only. Except for details connected with the smaller size the exuvia otherwise are very similar to these of *L. fittkaui* n. sp. and could conceivably be a form of that species.

Material examined: 94 exuvia, drift, Rio Negro, 2 km below Tapunquara, Brazil, 6/2/63, E.J. Fittkau.

Lopescladius sp. **C** (Fig. 6D)

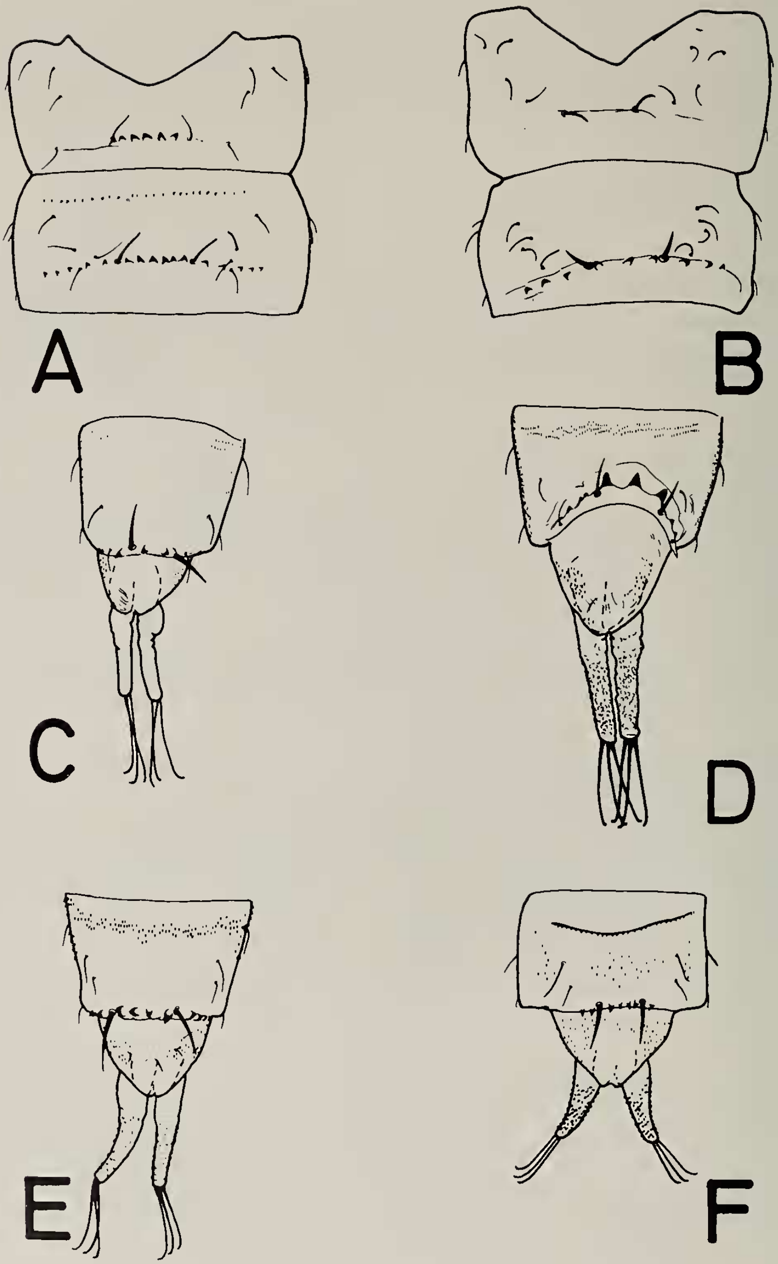
These exuvia have the digitiform anal lobe projection rugulose particularly medially. The frontal apotome also is weakly rugulose medially, while there is some slight rugulosity at base of the antennal sheaths. The size is about 2.0 mm, the digitiform anal lobe projections are 120-135μm, about 3.6-4.1 times as long as basally wide and about 1.3-1.4 times as long as the anal macrosetae. There are several caudal spines present on tergite I and the anterior transverse rows of spinules in the group shagreen are nearly complete.

Material examined: 4 exuvia, drift, Rio Marauia, Brazil, 28/1/63, E.J. Fittkau.

Lopescladius sp. **D** (Fig. 6E)

These exuvia have the digitiform anal lobe projection slightly wrinkled, but not rugulose. The projection is 109-116μm long, about 2.9-3.1 times as long as basally wide, and about 1.2-1.3 times as long as the anal macrosetae. The length of the exuvia are 1.81-1.95 mm and the coloration greyish brown. The frontal apotome, antennal and wing sheath are nearly smooth. Tergite I has about 6 caudal spines and the spinules in the anterior group shagreen are placed in a nearly continuous line.

The species appear close to *Lopescladius* sp. **C**.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Material examined: 17 exuvia, Panguana, Peru, 3° 37′S, 74° 56′W, ca. 260 m a.s.l. 3/4/82, E.J. Fittkau.

Lopescladius sp. E (Fig. 4B, E-F)

These exuvia have a pale yellowish brown coloration, a length of 1.43-1.52 mm; the digitiform projections are smooth, about 75-83μm long, and about 3.4-3.7 times as long as basally wide; and the anal macrosetae are 71-81μm long. They resemble *L. verruculosus* n. sp. in having the frontal apotome, antennal sheath and wing sheath covered with rugulosity. The rugulosity particularly of the frontal apotome (Fig. 4B) is weaker and while the tergites in *L. verruculosus* have a strong lateral rugulosity extending for most of the length of each segment (Fig. 4D), the lateral rugulosity of *Lopescladius* sp. *E.* is restricted to the median half (Fig. 4E).

The species could be a form of *L. verruculosus.*

Material examined: 23 exuvia, drift, Rio Tocantus near Baiao, Brazil, 28/10/1960, E.J. Fittkau.

Lopescladius sp. F (Fig. 6F)

These exuvia have a dark brown coloration, a size of 3.0-3.4 mm, the digitiform projections are distinctly rugulose (Fig. 5F) and about 150-160μm long, tergite I have a few caudal spines, the frontal apotome is weakly and partly rugulose, the antennal sheaths are smooth, the wing sheath have some rugulosity near apex, and the posterior bands of anterior spinules on the tergites are placed on a continuous transverse line.

Material examined: 5 exuvia, drift, middle part of Rio Prete da Eva, Estado Amazonas, Brazil, 14/10/1965, E.J. Fittkau.

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FIG. 6. *Lopescladius* spp., pupae. — A. *Lopescladius* sp. *A,* tergites I-II. — B. *Lopescladius* sp. *B,* tergites I-II. — C-F. Tergites VIII-IX and anal lobe. — C. *Lopescladius* sp. *B.* — D. *Lopescladius* sp. *C.* — E. *Lopescladius* sp. *D.* — F. *Lopescladius* sp. *F.*

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